

WHAT WE CLAIM ARE:

1. A semiconductor light emitting device comprising:
  - a support substrate made of a first semiconductor material;
  - a light emitting lamination structure disposed on the support
- 5 substrate, the light emitting lamination structure comprising a quantum well layer made of a second semiconductor material, a pair of carrier confinement layers made of a third semiconductor material having a band gap wider than a band gap of the second semiconductor material and sandwiching the quantum well layer, and a pair of clad layers made of a fourth semiconductor material having a band
- 10 gap wider than the band gap of the third semiconductor material and sandwiching layers comprising the quantum well layer and the pair of carrier confinement layers, wherein the second and third semiconductor materials and a thickness of the quantum well layer satisfy a condition that a difference of 100 meV or larger exists between an energy level of the carrier confinement layers at a conduction
- 15 band lower end and a ground level of an electron in the quantum well layer; and electrodes for injecting carriers into the light emitting lamination structure.
2. A semiconductor light emitting device according to claim 1, wherein a band
- 20 gap of the first semiconductor material is wider than an energy corresponding to a wavelength at which a peak of a light emission spectrum of the quantum well layer appears.
3. A semiconductor light emitting device comprising:
- 25 a support substrate made of a first semiconductor material;

a light emitting lamination structure disposed on the support substrate, the light emitting lamination structure comprising a quantum well layer made of a second semiconductor material, a pair of carrier confinement layers made of a third semiconductor material having a band gap wider than a band gap of the second semiconductor material and sandwiching the quantum well layer, and a pair of clad layers made of a fourth semiconductor material having a band gap wider than the band gap of the third semiconductor material and sandwiching layers comprising the quantum well layer and the pair of carrier confinement layers, wherein the second and third semiconductor materials and thicknesses of the quantum well layer and the carrier confinement layers satisfy a condition that light emission recombination of electrons and holes occurs in the quantum well layer and light emission recombination does not occur in the carrier confinement layers when current flows through the light emitting lamination structure; and electrodes for injecting carriers into the light emitting lamination structure.

4. A semiconductor light emitting device according to claim 1, wherein the first, third and fourth semiconductor materials are GaAs or AlGaAs, and the second semiconductor material is InGaAs.

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5. A semiconductor light emitting device according to claim 4, wherein an In composition ratio of the second semiconductor material is 0.05 to 0.25, and a relation between a thickness of the quantum well layer and the In composition ratio of the second semiconductor material satisfies a condition that an emission light wavelength is 800 to 920 nm.

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6. A semiconductor light emitting device according to claim 4, wherein an Al composition ratio of the third semiconductor material is 0.4 or smaller.
- 5 7. A semiconductor light emitting device according to claim 1, wherein a thickness of the carrier confinement layer is thinner than 120 nm.
8. A semiconductor light emitting device comprising:
- a support substrate made of group III-V compound semiconductor
- 10 and having a principal surface that is a (100) plane or a crystalline plane having an inclination angle of  $2^\circ$  or smaller from the (100) plane;
- a light emitting lamination structure disposed on the principal surface of the support substrate, the light emitting lamination structure comprising a quantum well layer made of group III-V mixed crystal semiconductor containing
- 15 In, a pair of carrier confinement layers made of semiconductor material having a band gap wider than the quantum well layer and sandwiching the quantum well layer, and a pair of clad layers made of semiconductor material having a band gap wider than the carrier confinement layers and sandwiching layers comprising the quantum well layer and the pair of carrier confinement layers, wherein
- 20 materials of the quantum well layer and the carrier confinement layers and a thickness of the quantum well layer satisfy a condition that a difference of 100 meV or larger exists between an energy level of the carrier confinement layers at a conduction band lower end and a ground level of an electron in the quantum well layer; and
- 25 electrodes for injecting carriers into the light emitting lamination

structure.

9. A semiconductor light emitting device according to claim 8, wherein the support substrate is made of GaAs and the quantum well layer is made of InGaAs.

10. A semiconductor light emitting device according to claim 8, wherein an In composition ratio of the quantum well layer is 0.12 or smaller.

10 11. A semiconductor light emitting device comprising:

a support substrate made of group III-V compound semiconductor and having a principal surface that is a (100) plane or a crystalline plane having an inclination angle of  $0.2^\circ$  or smaller from the (100) plane;

a light emitting lamination structure disposed on the principal surface of the support substrate, the light emitting lamination structure comprising a quantum well layer made of group III-V mixed crystal semiconductor containing In, a pair of carrier confinement layers made of semiconductor material having a band gap wider than the quantum well layer and sandwiching the quantum well layer, and a pair of clad layers made of semiconductor material having a band gap wider than the carrier confinement layers and sandwiching layers comprising the quantum well layer and the pair of carrier confinement layers, wherein materials of the quantum well layer and the carrier confinement layers and a thickness of the quantum well layer satisfy a condition that a difference of 100 meV or larger exists between an energy level of the carrier confinement layers at a conduction band lower end and a ground level of an electron in the quantum

well layer; and

electrodes for injecting carriers into the light emitting lamination structure.

- 5 12. A semiconductor light emitting device according to claim 11, wherein the support substrate is made of GaAs, the quantum well layer is made of InGaAs, and an In composition of the quantum well layer is 0.25 or smaller.

13. A semiconductor light emitting device comprising:

- 10 a support substrate made of group III-V compound semiconductor and having a principal surface that is a (100) plane or a crystalline plane having an inclination angle of 2° or smaller from the (100) plane;

- a light emitting lamination structure disposed on the principal surface of the support substrate, the light emitting lamination structure comprising
- 15 a quantum well layer made of group III-V mixed crystal semiconductor containing In, a pair of carrier confinement layers made of semiconductor material having a band gap wider than the quantum well layer and sandwiching the quantum well layer, and a pair of clad layers made of semiconductor material having a band gap wider than the carrier confinement layers and sandwiching layers comprising
- 20 the quantum well layer and the pair of carrier confinement layers, wherein materials of the quantum well layer and the carrier confinement layers and thicknesses of the quantum well layer and the carrier confinement layers satisfy a condition that light emission recombination of electrons and holes occurs in the quantum well layer and light emission recombination does not occur in the carrier
- 25 confinement layers; and

electrodes for injecting carriers into the light emitting lamination structure.

14. A semiconductor light emitting device according to claim 13, wherein the  
5 support substrate is made of GaAs and the quantum well layer is made of InGaAs.

15. A semiconductor light emitting device according to claim 13, wherein an In composition ratio of the quantum well layer is 0.12 or smaller.

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16. A semiconductor light emitting device comprising:

a support substrate made of group III-V compound semiconductor and having a principal surface that is a (100) plane or a crystalline plane having an inclination angle of  $0.2^\circ$  or smaller from the (100) plane;

15 a light emitting lamination structure disposed on the principal surface of the support substrate, the light emitting lamination structure comprising a quantum well layer made of group III-V mixed crystal semiconductor containing In, a pair of carrier confinement layers made of semiconductor material having a band gap wider than the quantum well layer and sandwiching the quantum well  
20 layer, and a pair of clad layers made of semiconductor material having a band gap wider than the carrier confinement layers and sandwiching layers comprising the quantum well layer and the pair of carrier confinement layers, wherein materials of the quantum well layer and the carrier confinement layers and thicknesses of the quantum well layer and the carrier confinement layers satisfy a  
25 condition that light emission recombination of electrons and holes occurs in the

quantum well layer and light emission recombination does not occur in the carrier confinement layers when current flows through the light emitting lamination structure; and

electrodes for injecting carriers into the light emitting lamination

5 structure.

17. A semiconductor light emitting device according to claim 16, wherein the support substrate is made of GaAs, the quantum well layer is made of InGaAs, and an In composition ratio of the quantum well layer is 0.25 or smaller.

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18. A semiconductor light emitting device comprising:

a support substrate made of group III-V compound semiconductor and having a principal surface that is a (100) plane or a crystalline plane having an inclination angle of 5° or smaller from the (100) plane;

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a light emitting lamination structure disposed on the principal surface of the support substrate, the light emitting lamination structure comprising a quantum well layer made of group III-V mixed crystal semiconductor containing In and having an In composition ratio of 0.12 or smaller, a pair of carrier confinement layers made of semiconductor material having a band gap wider than the quantum well layer and sandwiching the quantum well layer, and a pair of clad layers made of semiconductor material having a band gap wider than the carrier confinement layers and sandwiching layers comprising the quantum well layer and the pair of carrier confinement layers, wherein materials of the quantum well layer and the carrier confinement layers and a thickness of the quantum well

25 layer satisfy a condition that a difference of 100 meV or larger exists between an

energy level of the carrier confinement layers at a conduction band lower end and a ground level of an electron in the quantum well layer; and electrodes for injecting carriers into the light emitting lamination structure.

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19. A semiconductor light emitting device comprising:

a support substrate made of group III-V compound semiconductor and having a principal surface that is a (100) plane or a crystalline plane having an inclination angle of  $5^\circ$  or smaller from the (100) plane;

10 a light emitting lamination structure disposed on the principal surface of the support substrate, the light emitting lamination structure comprising a quantum well layer made of group III-V mixed crystal semiconductor containing In and having an In composition ratio of 0.12 or smaller, a pair of carrier confinement layers made of semiconductor material having a band gap wider  
15 than the quantum well layer and sandwiching the quantum well layer, and a pair of clad layers made of semiconductor material having a band gap wider than the carrier confinement layers and sandwiching layers comprising the quantum well layer and the pair of carrier confinement layers, wherein materials of the quantum well layer and the carrier confinement layers and thicknesses of the quantum well  
20 layer and the carrier confinement layers satisfy a condition that light emission recombination of electrons and holes occurs in the quantum well layer and light emission recombination does not occur in the carrier confinement layers; and electrodes for injecting carriers into the light emitting lamination structure.

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